Spotted Wing Drosophila Degree-Day Model ***Drosophila suzukii*** **(Matsumura)**

Len Coop – Presumptive model analysis March 23, 2010 version 1.5 – Use with caution

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Main refs: 1. Kanzawa, T. 1939 Studies on Drosophila suzukii Mats., 49 pp. (translated and on file)

2. Sakai, M. and Sato, R. 1996. Bionomics of Drosophila pulchrella Tan, Hsu et Sheng (Diptera: Drosphilidae) in Fukushima Prefecture. Fukushima Fruit Tree Exper. Sta.

Additional ref: 3. http://www.agri.state.id.us/Categories/PlantsInsects/RegulatedAndInvasiveInsects/Documents/2010%20Spotted%20Wing%20Drosophila.pdf (citing Kanzawa 1939)

4. Uchino 2005. Distribution and seasonal occurrence of cherry Drosophila suzukii injurious to blueberry in Chiba Prefecture. http://www/ktpps.org/pdf/journal/52(2005)_body_22.pdf

Max Generations (304 Dds min. gen. time)		Presumptive Model: Dds	Event
2	858	250	Initial activity by OW females
3	1162	490	50% oviposition by OW females
4	1466	504	first emergence 1st gen females
5	1770	554	fist egg laying by 1st gen females
6	2074	858	Max 2 gens assuming first eggs survived to reproduce
7	2378	984	50% oviposition by 1st gen females; max 2+ gens
8	2682	1478	50% oviposition by 2nd gen females; max 4+ gens
9	2986	1972	50% oviposition by 3rd gen females; max 5+ gens
10	3290	2466	50% oviposition by 4th gen females; max 7+ gens
11	3594	2960	50% oviposition by 5th gen females; max 9 gens

Model:	Dds (50)
Spring initial activity	250 (based on Uchino 2003 data)
1st egglaying when Tmax exceeds ??F (to be determined)	
Egg	17
Larval	125
Pupal	112
Total Egg to Adult Development	254
Pre-OV (Emerge to 1st eggs)	50 (2-3 days under lab conditions)
Emerge to 50% OV	240
Total 1st OV to 1st OV gen. Time	304
Total 50% OV to 50% OV gen. Time	494

1. Initial Spring Emergence and Egg laying

Kanzawa reports: Activity begins early April; egg laying begins in April

Uchino 2005: Adult emergence observed April 23 2003 (Kisarazu City, Chiba, Japan) – calculated from data to be 250 Dds

2. Pre-Oviposition requirement (use same Tlow=50F Thi=88F)

Kanzawa 1939 – Analysis below

Based on Table 7:

1.2 to 7.2 days; average 80+/- Dds

Sakai & Sato 1996 Temp C	Temp F	Pre-OV Period days	Dds (50)
18	64.4	7	100.8
22	71.6	4.9	105.84
25	77	3	81
28	82.4	4	129.6
		avg	104.31
		range	81 to 129

NOTE:

USDA Corvallis observes females ovipositing within 2-3 days after emergence in lab = Use value of 50DDs for pre-oviposition period

3. Oviposition Schedule (again Tlow=50 Thi=88F)

Kanzawa 1939 -Table 10

Oviposition period range 10-59 days avg=38.9 days at avg Temp=68.6 F

38.9 x (68.6-50) = 723.54 Dds (50) '= maximum (1) oviposition

Assume w/mortality and left-skewed OV schedule; 50% of eggs deposited within 1/3 of this interval = 241 DDs (50)

Use 240 Dds for Emerge to 50% OV in model

4. Temperature- Development of each life stage

Studies Combined

Egg to Adult Development at various temperatures:

	Temp C	Temp (F)	1/days	days	Dds (50)	Dds (48)
					Lowest CV (check only)	
Kanzawa->	12	53.6	0.0200	50		
	18	64.4	0.0526	19	273.6	311.6
	25	77	0.1042	9.6	259.2	278.4
	28	82.4	0.1429	7	226.8	240.8
	15	59	0.0444	22.5	202.5	247.5
Sak&Sat->	18	64.4	0.0526	19	273.6	311.6
	22	71.6	0.0735	13.6	293.76	320.96
	25	77	0.1042	9.6	259.2	278.4
exclude->	28		0.1042	9.6		

Kyokai 2003 '->this study is somewhat unclear but generally confirms development rates to be same as Kanzawa at 15 and 25 C
'e. g. “duration from oviposition to emerg. Is short like over 20 days at 15C or about 10 days at 25C”

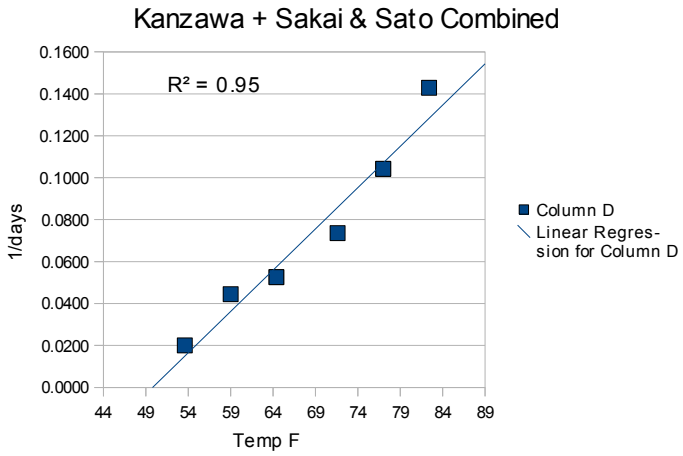
	model:	intercept:	-0.196	mean	255.52
		slope:	0.00394	stdev	31.04
DD requirement =		1/slope:	253.95	CV	12.15
Lower dev. threshold =		X-intercept:	49.81		
		Rsq:	0.95393		

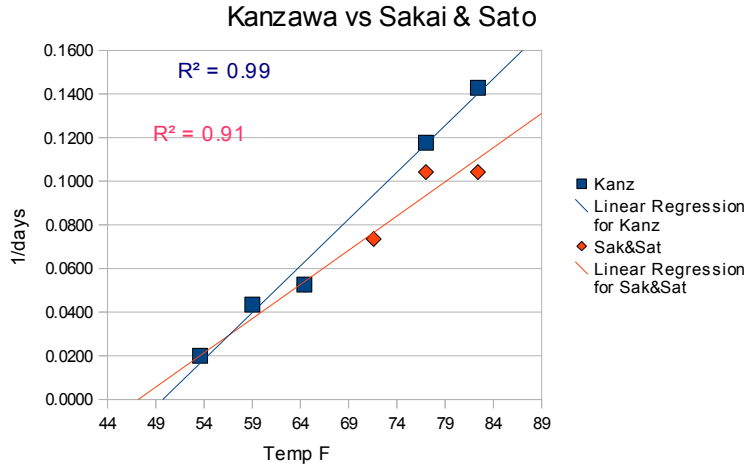
Studies Compared

Egg to Adult Development at various temperatures:

	Temp C	Temp (F)	Kanz	Sak&Sat	days
Kanzawa->	12	53.6	0.0200		50
	18	64.4	0.0526		19
	25	77	0.1176		8.5
	28	82.4	0.1429		7
	15	59	0.0435		23
Sak&Sat	18	64.4		0.0526	19
	22	71.6		0.0735	13.6
	25	77		0.1042	9.6
	28	82.4		0.1042	9.6

	model:	intercept:	-0.213	-0.148	
		slope:	0.00429	0.0031	
DD requirement =		1/slope:	233.12	319.08	
Lower dev. threshold =		X-intercept:	49.72	47.17	
		Rsq:	0.98728	0.9139	





Revised model summary: Egg-Adult Devel = 254 DD above 50F and below 88F

5. Proportionate development Egg/Larval/Pupal

Kanzawa (Tables 16 & 17)

	Days at 15 C	Proportion	25 C	ProporticAvg	Dds (50)	Values to Use		Check: Dds (50) 15C only	Check: DDs (50) 25C only
Egg	1.83	7.8	0.54	5.66	6.73	17.1	17	19.82	14.38
Larval	11.08	47.25	4.46	46.75	47	119.38	125	120.01	118.75
Pupal	10.54	44.95	4.54	47.59	46.27	117.52	112	114.16	120.88
Total	23.45	100	9.54	100	100	254	254	254	254

Development requirements: Egg=17 Dds, Larvae=125 Dds, Pupae=112 Dds 254 ←check